Reconstruction of Electrospray Emitted Current Using Computed Tomography

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This work aims to reconstruct the current emitted by an electrospray thruster using computed tomography, a technique that enables detailed, cross-sectional imaging of the emission pattern. Electrospray thrusters, known for their efficiency in space propulsion, require precise characterization of their emission profiles to optimize performance.

An experimental setup was developed featuring ATHENA, an electrospray thruster designed at ienai SPACE, along with a tomography assembly that includes a wire collector and two motion stages: linear and rotary. This configuration allows for precise scanning of the thruster's emission profile.

To facilitate the reconstruction process, MATLAB codes were developed to simulate the emission patterns under various conditions. These simulations played a crucial role in visualizing expected outcomes and optimizing experimental parameters, such as the distance between the wire and the thruster, as well as the number of steps required for accurate data collection. Data was generated across voltage levels ranging from 700 V to 1300 V, which was used to create graphical representations of current intensity as a function of the stages' positions, known as sinograms. These sinograms were then processed using the inverse Radon transform to reconstruct the emission pattern as an image.

The resulting images aligned with the simulation predictions, and revealed non-uniform emission across the thruster. This non-uniformity, although expected due to manufacturing tolerances, provides valuable insights into the thruster's performance characteristics. The detailed analysis of these images suggests that certain regions of the thruster may require design modifications to improve emission uniformity.